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Preliminary Amendment Accompanying
Substitute Specification

## REMARKS

Drawings – Figures 1-19 have been amended to reflect the addition of reference numerals and 17 sheets of drawings are presented herewith for approval.

The substitute specification enclosed herein contains no new matter.

The Director is authorized to charge any additional fees due by way of this Amendment, or credit any overpayment, to our Deposit Account No. 19-1090.

All of the claims remaining in the application are now clearly allowable. Favorable consideration and a Notice of Allowance are earnestly solicited.

Respectfully submitted,

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RCV:alb

Enclosures:
- Postcard
- 17 Replacement Sheets for Drawings (Figs. 1-19)
- Redlined Substitute Specification
- Substitute Specification

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# ROTOR BLADE ~~OF~~ FOR A WIND POWER INSTALLATION

## BACKGROUND OF THE INVENTION

### Field of the Invention

The invention concerns a rotor blade of a wind power installation, and a wind power installation. As state of the art in this respect attention should be directed generally to the book 'Windkraftanlagen', Erich Hau, 1996. That book contains some examples of wind power installations, rotor blades of such wind power installations as well as cross-sections of such rotor blades from the state of the art. Page 102, Figure 5.34, illustrates the geometrical profile parameters of aerodynamic profiles in accordance with NACA. It is to be seen in that respect that the rotor blade is described by a profile depth which corresponds to the length of the chord, a greatest camber (or camber ratio) as the maximum rise of a median line over the chord, a camber reserve, that is to say the location with respect to the profile depth where the greatest camber is provided within the cross-section of the rotor blade, a greatest profile thickness as the largest diameter of an inscribed circle with the ~~centre~~center point on the median line and the thickness reserve, that is to say the location with respect to the profile depth where the cross-section of the rotor blade assumes its greatest profile thickness. In addition the leading-edge radius and the profile co-ordinates of the underside and the top side are brought into consideration to describe the cross-section of the rotor blade. The nomenclature known from the Erich Hau book is to be retained *inter alia* for the further description of the cross-section of a rotor for the present application.

Description of the Related Art

Rotor blades are to be ~~optimised~~optimized in regard to a large number of aspects. On the one hand they should be quiet while on the other hand they should also afford a maximum dynamic power so that, even with a quite slight wind, the wind power installation begins to run and the nominal wind speed, that is to say the speed at which the nominal power of the wind power installation is also reached for the first time, is already reached at wind strengths which are as low as possible.

If then the wind speed rises further, nowadays when considering pitch-regulated wind power installations the rotor blade is increasingly set into the wind so that the nominal power is still maintained, but the operative surface area of the rotor blade in relation to the wind decreases in order thereby to protect the entire wind power installation or parts thereof from mechanical damage. It is crucial however that great significance is attributed to the aerodynamic properties of the rotor blade profiles of the rotor blade of a wind power installation.

BRIEF SUMMARY OF THE INVENTION

~~The object~~One advantage of the present invention is to provide a rotor blade having a rotor blade profile and a wind power installation, which involve better efficiency than hitherto.

The advantage may be ~~In accordance with the invention that object is~~ attained by a rotor blade having a rotor blade profile with the features as set forth in one of the independent claims. Other ~~A~~advantageous developments are described in the appendant claims.

The specific co-ordinates of a rotor blade profile according to the invention are set forth in a Table 1.

## BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWINGS

The invention is illustrated hereinafter by a number of drawings in which:

Figure 1 shows a perspective view from the front of a wind power installation according to the invention,

Figure 2 shows a perspective view of a wind power installation according to the invention from the rear and the side,

Figure 3 shows a view of a wind power installation according to the invention from the side,

Figures 4 - 8 show views of a rotor blade according to the invention from various directions,

Figure 9 shows a view on an enlarged scale of a wind power installation according to the invention,

Figure 10 shows a view of a rotor blade according to the invention,

Figures 11 - 17 and 19 show various views of a wind power installation according to the invention, and

Figure 18 shows a cross-section of a rotor blade according to the invention (in the region near the hub).

## DETAILED DESCRIPTION OF THE INVENTION

Figure 18 shows ~~T~~the rotor blade profile described in accordance with ~~the present application is provided~~one illustrated embodiment. ~~i~~In particular, in the region of the rotor blade which adjoins the rotor blade connection, (for connection to the hub) the profile is of a selected size and shape. ~~Preferably t~~The profile described in the present ~~application~~ embodiment is provided in the first third of the rotor blade 1, with respect to the overall length of the rotor blade 1. In this respect the overall length L of a rotor blade 1 may definitely be in the range of between 10 m and 70 m, depending on the nominal power which a wind power installation is to involve. Thus, for example, the nominal power of a wind power

installation from the corporation Enercon of type E-112 (diameter about 112 m) is 4.5 MW while the nominal power of a wind power installation from Enercon of type E-30 is 300 KW.

What is particularly characteristic in terms of the profile of the rotor blade 1 according to the invention is that the greatest profile thickness is between about 25% and 40%, preferably between 32% and 36%, of the length of ~~the~~ a rotor blade chord 9. In Figure 18, the greatest profile thickness is about 34.6% of the length of the rotor blade chord 9. ~~Shown in Figure 1 is a~~The chord ~~1~~9 ~~which~~ extends from the ~~centre~~center 2 of the rotor blade trailing edge 3 to the foremost point 4 of the rotor blade leading edge 5. The thickness reserve TR, that is to say the location in relation to the blade length where the greatest profile thickness occurs, is between about 20% and 30% of the length of the chord, preferably between 23% and 28%, and about 25.9% in the illustrated exampl~~e being 25.9%~~. The greatest thickness ~~was~~ is ascertained perpendicularly to the chord 9 and the reserve TR is related to the rotor blade leading edge.

In addition, Figure 18 shows ~~what is known as the~~ mean camber line 7. ~~That~~ The camber line 7 results from half the respective thickness of the rotor blade ~~8~~ 1 at a point. Accordingly, ~~that~~ the camber line 7 does not extend in a straight line, but instead extends ~~always exactly~~ between oppositely disposed points on ~~the~~ an increased-pressure side ~~9~~ 10 of the rotor blade ~~7~~ 1 and ~~the~~ a reduced-pressure side ~~10~~ 11 of the rotor blade ~~7~~1. The camber line 7 intersects the chord 9 at the trailing edge 3 of the rotor blade 1 and the leading edge 5 of the rotor blade 1.

The camber reserve CR in the cross-section of a rotor blade 1 ~~according to the invention~~ is located between about 55% and 70% of the length of the chord 9, and preferably between about 59% and 63%. In the illustrated example the camber reserve CR is located at about 61.9% of the length of the chord 9. ~~In this case the greatest~~ The amount of camber 11 ~~is~~ at the camber reserve CR can be between about 4% and 8% of the length of the chord, and

preferably between about 5% and 7% of the length of the chord. In the illustrated example, the camber "C" is about 5.87% of the length of the chord.

It is further particularly striking in terms of the profile of the rotor blade 1 ~~according to the invention~~ that the ~~increased~~reduced-pressure side 11 of the rotor blade 1 'cuts' the chord twice at points 12 and 13.~~,~~ ~~t~~That is to say in that ~~region~~ the ~~increased~~reduced-pressure side 11 of the profile is of a concave configuration, while in the front region of the profile, the increased-pressure side 10 is of a convex configuration. In the region where the increased-pressure side 10 is of a convex configuration, in the corresponding, oppositely disposed region on the reduced-pressure side 11, ~~the latter~~this region 14 is delimited by an almost straight line.

~~It may certainly have been~~While it might be previously known for the ~~increased~~reduced-pressure side 11 to be provided with a concave curvature or for the ~~reduced~~increased-pressure side 11 to be provided with a straight-line boundary as individual components, the combination of having one opposite the other is a new feature according to invention. In particular, the combination of those two measures is ~~however of great significance for~~significant in the profile of ~~a~~ the rotor blade 1 according to the invention and is characteristic in respect of the rotor blade profile according to the invention.

The rotor blade trailing edge 3 of the illustrated profile is also noticeably thick. ~~That~~ This thickness, however, does not cause any problem in regard to the creation of sound at the trailing edge 3 of the rotor blade 1 because the illustrated profile is in the inner third of the rotor circle and there the orbital speed is not very high.

One embodiment of ~~T~~the x-y-co-ordinates of the profile is shown in ~~the~~ Figure 18 ~~are~~ and is reproduced in Table 1. ~~and thus t~~The profile of the rotor blade 1 ~~according to the invention is~~ can be made ~~exactly~~ substantially as described ~~therewith~~herein. Of course, variations from Table 1 are possible and the

invention can still be obtained; use of the exact x-y values in Table 1 is not required.

As shown in Figure 1, ~~T~~to improve the aerodynamic shape of the rotor blade, it is of such a configuration, in the general region of the rotor blade root 15, that there it is of its greatest width W and thus the rotor blade 1 is of a trapezoidal shape (in plan) which is more or less approximated to the optimum aerodynamic shape. Preferably in the region of the rotor blade root 15, the rotor blade 1 is of such a configuration that the edge 16 of the rotor blade root 15, which is towards ~~the~~ a pod 18 of a wind power installation (Figure 15), is adapted to the external contour of the pod cladding 20 of the pod 18 in at least one angular position, for example it is adapted in such a way that a very small spacing S, for example a spacing S of between about 5 mm and 100 mm, exists between the pod cladding 20 and the edge 16 of the rotor blade root 15 which is towards the wind power installation and the external contour of the pod cladding 20 when the rotor blade 1 is positioned in the nominal wind position.

A rotor blade 1 with the above-indicated properties affords a significantly higher increase in power~~, in part~~ of about up to 10%. By virtue of that increase in power ~~which could not be predicted~~, a wind power installation ~~according to the invention,~~operating at a ~~given~~ wind speed below the nominal wind speed, ~~achieves~~ can achieve a higher power output. In addition, ~~it~~ the wind power installation reaches its nominal power output earlier than hitherto. Accordingly, the rotor blades 1 can also be rotated ~~(pitched) earlier and this~~to a pitched position, which can ~~provides that the level of~~reduce sound emission ~~on the one hand~~ and the mechanical loading on the installation ~~on the other hand fall~~.

In that respect the invention is based on the ~~realisation~~realization that the rotor blade shape which is common nowadays is investigated in a wind tunnel admittedly using different wind speeds but with an air flow which is always uniform. ~~As i~~In nature, ~~however~~ it is ~~in the rarest~~rare ~~cases~~ that the wind blows uniformly ~~in terms of surface area~~, but rather the wind is subject to a stochastic law. ~~, the~~

~~known~~ Standard rotor blade~~s~~ profiles, as a consequence of gusts, involve detachment of the flow precisely in the inner region of the blade near the rotor hub 17 where the blade ~~is in fact~~ no longer ~~of~~ has an aerodynamically clean and optimum configuration. ~~That~~ This flow detachment ~~phenomenon~~ phenomena is propagated a distance along the rotor blade 1 in the direction ~~of~~ towards the ~~outer region thereof, which is (~~rotor blade tip~~)~~. As a result, the flow can become detached from the rotor blade1 in a bubble-shaped region and thus result in corresponding power losses. In the case of the present invention and ~~having~~ in regard to the above-described ~~basic~~ situation, ~~therefore~~ it is possible to achieve a considerable increase in power output by virtue of a rotor blade 1 which is of a clean configuration ~~also~~ in the inner region of the rotor blade according to the embodiments of the present invention.

If now a known standard profile were to be used instead of the empirically ascertained blade profile, which is ~~proposed in the present application~~described herein, then, to afford an aerodynamically clean configuration for the rotor blade, approximately double the profile depth ~~(this corresponds~~relative to the length of the chord of the rotor blade~~)~~ ~~would~~ could be required in the region of the~~lower~~ rotor blade ~~region (the region~~ near the hub 17~~)~~. The ~~great~~ profile thickness in the front region~~, however, is required for securely and reliably transmitting the~~ permits the transmission of air loads ~~involved~~ and permits the rotor blade to attain a lift value $C_A$ ~~of~~ greater than 2.

As is known from the state of the art, rotor blades are ~~nowadays~~ usually constructed~~, which~~ to entail a ~~great~~ saving ~~in~~ of material to the greatest possible extent in the inner region. Typical examples in that respect are disclosed in the state of the art, which has already been referred to above, in 'Windkraftanlagen', Erich Hau, 1996, on pages 114 and 115. It can be seen therein that the greatest profile depth is always attained at a certain distance from the rotor blade connection, that is to say in the region near the rotor blade connection, in which respect material is saved in those rotor blades in accordance

with the state of the art. If, however, ~~an optimum~~ a shape ~~which approximates to~~approximating a trapezoidal shape is used ~~in plan~~, then the greatest width of a rotor blade is not ~~for example~~ at a spacing relative to the rotor blade connection but precisely in the region of the rotor blade connection itself. That structure then therefore does not save the greatest possible amount of material in the inner region of the rotor blades.

The ~~cause of the~~ approach to saving in material, as described above, has been developed by ~~which has been implemented hitherto lies in~~ considering the static manner of ~~considering~~ the flow conditions ~~(as described hereinbefore)~~ in regard to calculating/developing the rotor blades 1. ~~Added to that is the fact that~~ In addition, current calculation programs for rotor blades divide the rotor blade 1 into individual ~~spacings~~ portions and calculate each rotor blade portion in itself in order to derive ~~therefrom the~~ an evaluation for the overall rotor blade.

~~It will be noted however that the reality looks somewhat different. On the one hand the~~As noted above, wind does not blow uniformly and statically ~~within~~ over a given surface area region, but markedly exhibits a stochastic ~~behaviour~~behavior. ~~, while on the other hand, by virtue of the~~The low peripheral speed of the rotor blade 1 in the inner region ~~(that is to say in the region~~ near the rotor hub~~)~~ 19 ~~the~~ influences ~~of~~ the wind speed ~~is considerable and accordingly~~ and may cause the angle -of incidence to changes in that region ~~with a high level of dependency~~in response to and dependant on the instantaneous wind speed. As a consequence, ~~thereof~~ detachment of the flow from the rotor blade 1 ~~also correspondingly~~can frequently occurs in the inner region of the rotor blade 1.

A hysteresis effect is operative in such a situation. When the previous wind speed occurs again, that is to say after a gust is past, the flow is not the same at the rotor blade 1 again. Rather, the wind speed firstly has to fall further (the angle of incidence must therefore be further changed) until the ~~flow~~ air again bears against the surface of the rotor blade 1. If, however, the wind speed does not ~~fall further~~decrease, it may certainly happen that, for a prolonged period

of time, in spite of the afflux flow of the wind to the rotor blade 1, a relevant force is exerted on the rotor blade 1 because the flow has not yet come to ~~lie~~ bear against (i.e., flow cleanly over) the rotor blade surface again.

The risk of flow detachment ~~is markedly~~can be reduced by ~~virtue of~~ the embodiments of the rotor blade ~~configuration according to the invention~~described herein ~~of the rotor blade~~. ~~That~~ For example, the detachment risk is ~~also~~ reduced by the relatively thick profile. ~~The considerable~~ The thick profile of rotor blade 1 provides an increase in power can also be well explained by virtue of ~~the fact that,~~ due to the hysteresis effect, once flow detachment has occurred, the power losses are maintained over a considerable period of time ~~(~~for rotor blades in accordance with the state of the art~~)~~.

A further part of the increase in power can be explained by virtue of the fact that the wind follows the path of least resistance. Thus, ~~I~~if ~~therefore~~ the rotor blade is very thin in the inner region near the hub 17 ~~(great~~because of saving ~~of~~ material~~)~~, ~~that~~ then this ~~is equivalent to~~can be viewed as a 'slip hole' in the harvesting area of the rotor circle (i.e., around and proximate to the pod 18), through which ~~hole the~~ air preferentially flows. In this case, ~~also~~ it is ~~certainly~~ possible to see ~~a weakness in~~that the common calculation programs ~~which are always~~ based on uniform distribution over the rotor circle area may not be sufficiently accurate.

In one embodiment as best illustrated in Figures 3 and 11, ~~If now that~~the 'slip hole' ~~is~~ can be 'closed' by virtue of the trapezoidal configuration of the rotor blade 1 in the region near the hub 17, ~~that will afford~~then an improved distribution of ~~the~~ air flow over the entire circular surface area ~~and thus~~ can be achieved. In addition, the ~~effect on~~efficiency of the outer region of the rotor blade is also increased somewhat. Accordingly, ~~therefore the step of~~ 'closing' ~~that~~ the 'slip hole' makes a contribution to the higher power output of the rotor blade 1 ~~according to the invention~~.

~~This is a further weak point~~Another insufficiency of the current calculation programs ~~for~~ is that they ~~also~~ consider the rotor blade portion directly adjoining the 'slip hole' as a full-value rotor blade portion which it cannot be, because of the particular flow conditions, which results in frequent ~~(frequent~~ flow breakdowns ~~and later restoration of the intended flow conditions)~~.

Figures 3 and 11 ~~11 to 17~~ show ~~a view of~~ a wind power installation according ~~to the invention from the front or from the sideto~~ one illustrated embodiment. ~~It can be seen in that respect Figure 11 shows how t~~The three rotor blades 1 have an almost seamless transition ~~into~~ with respect to the external configuration of the pod cladding 21 and with respect to the hub cladding 19~~, in the blade region near the hub 19~~ when~~. This applies however only in regard to the position of~~ the rotor blades 1 ~~insofar as they~~ are in ~~the~~ a nominal wind position.

Figure 9 illustrates that ~~If~~ if the wind ~~then rises further~~increases above ~~the~~ nominal wind speed, then ~~as usual~~ the rotor blades 1 are moved slowly ~~out of~~ to change their pitch to the wind by pitch control or ~~(~~pitch regulation~~),~~ and ~~Figure 15 shows that in that case there is indeed~~ a larger spacing "S" develops between the lower edge 16 of the rotor blade 1 ~~in the inner region~~ and the hub cladding 19 and pod cladding 21, respectively~~pod~~. Figure 11, however, ~~also~~ shows that ~~provided on~~when the contour of ~~outside of~~ the hub cladding 19 and the contour of the pod cladding 21 ~~is a structure which in its cross-section very~~ substantially correspond~~s~~ to the edge profile of the rotor blade 1 in the region near the hub 19 and which, when the rotor blade 1 is set in an angle of incidence at the nominal speed, is directly below the rotor blade so that there is only a small gap "S" between the structure and the rotor blade in the region near the hub.

~~Accordingly, the external contour of the pod 18 also includes a part of the rotor blade, which is not an integral constituent part of the rotor blade 1.~~

When the rotor blade 1 is in the feathered position, with reduced surface area towards the wind, the rotor blade 1 is parallel to the lower edge 16 that is towards the pod 18 and the spacing between the lower edge 16 and the

external contour of the pod cladding 21 is at a minimum, preferably being less than 50 cm or even less than 20 cm.

When the rotor blade 1 is set into the wind, it involves a large surface area even in the very near region of the rotor blade (the slip hole is very small). The above-mentioned reference Erich Hau shows that the rotor blade in the state of the art decreases regularly in the region near the hub 17 (the rotor blades are there less wide than at their widest location). Conversely, the widest location of the rotor blade 1 according to at least one embodiment of the invention is in the region near the hub 17 so that the wind can be utilized to the best possible extent.

~~In the case of~~ Referring back to the rotor blade profile shown in Figure 18, the leading edge radius 5 is approximately 0.146 of the profile depth.

~~As can be seen from Figure 18, provided at the~~The reduced-pressure side 10 ~~is~~ has a longer, almost straight region. ~~That can be described for example as follows: i~~In ~~the~~ this region, at between 38% and 100% of the profile depth, the radius is about 1.19 times the length of the profile depth. ~~In the region of b~~Between 40% and 85% of the profile depth, ~~(see Figure 18)~~ the radius is about 2.44 ~~multiplied by~~times the profile depth. ~~In the region of~~ And, between 42% and 45% of the profile depth, the radius is about 5.56 times of the profile depth.

In the region ~~of~~ between 36% and 100% of the profile depth, the maximum deviation from ~~the~~ an ideal straight line is about 0.012 of the profile length. ~~That~~ This value is ~~the crucial value~~an important variable as the curvature radius varies and the greatest curvature radius is already specified in the respective regions.

In the illustrated ~~example~~ embodiment of Figure 18, the length of the reduced-pressure side 10 is about 1.124 of the length of the profile depth while the length of the increased-pressure side 11 is 1.112 of the length of the profile depth. This means that the reduced-pressure side 10 is only immaterially longer than the increased-pressure side 11. It is ~~therefore highly~~ advantageous if the ratio of the

reduced-pressure side 10 length to the increased-pressure side 11 length is less than 1.2, preferably less than 1.1 or in a range of values of between 1 and 1.03.

It can be seen from the illustrated Figures that the rotor blade 1 has its greatest profile depth directly at the spinner or hub 17, that is to say at the outside of the pod 18 of the wind power installation. ~~Thus for example in the case of~~For a wind power installation with a rotor diameter of 30 m, the profile depth at the spinner 17 is between about 1.8 ~~and~~ to 1.9, preferably 1.84. If then the spinner 17 is approximately of a diameter of 3.2 mm, the ratio of the profile depth of the rotor blade 1 at the spinner to the spinner diameter is about 0.575. It is ~~therefore highly~~further advantageous if the ratio of the profile depth to the spinner diameter is greater than a value of 0.4 or in a range of values of ~~between~~ about ~~0.5 and~~0.4 to 1. ~~In that respect each value can be assumed to be in the above-indicated range.~~ In the above-specified example, the ratio of the profile depth to the rotor diameter is about 0.061. ~~It is apparent that therefore t~~The 'slip hole' ~~is~~ can be made as small as possible if the ratio of the profile depth to the rotor diameter is greater than a value of between 0.05 and 0.01~~, in which respect the value given by way of example has proven to be extremely appropriate, as regards the efficiency of the rotor blade~~.

In ~~A~~another example, ~~would be~~ a rotor blade 1 with ~~the~~ a profile cross-section similar to the one shown in Figure 18, ~~in~~ the first third of the profile, ~~in which respect the~~ has a profile depth at the spinner ~~is~~ of about 4.35 mm, ~~the~~ a spinner diameter ~~is~~ of 5.4 m and ~~the~~ a rotor diameter ~~is overall~~of about 71 m. ~~Then~~ Thus, the value of the profile depth to the spinner diameter is 0.806 and the ratio of the profile depth to the rotor diameter is again 0.061. The above-indicated values relate to a triple-blade rotor with pitch regulation.

As described, ~~in the case of the~~ a rotor blade 1 according to ~~one~~another embodiment of the invention ~~the widest location (the location with the~~can have its greatest profile depth~~) of the rotor blade can be directly~~ in the region ~~of the blade connection~~ near the hub 17 and the rotor blade 1 can further

include the~~. The blade connection~~ rotor blade portion 30. Figure 15 illustrates the rotor blade portion 30, which is a physically separable component with respect to the rotor blade 1, but is considered to a functional part of the rotor blade 1 with respect to carrying air loads. The rotor blade portion 30, although not an integral part of the rotatable rotor blade 1, can be an integral, constituent part of the hub cladding 19 or affixed to the hub cladding 19 of the hub 17, which is further a part of the pod 18, in a variety of ways ~~is the region in which the rotor blade is connected~~ (e.g., joined, screwed and so forth)~~ to the hub 1 of the wind power installation~~. In addition the lower edge of the rotor blade portion 30, that is to say the edge which faces towards the pod of the wind power installation, ~~is very~~can be substantially adapted to or matched to the external contour of the hub cladding 19 and/or pod cladding 21~~pod~~ in the longitudinal direction. Accordingly in this case, when a rotor blade 1 is in the feathered position, (practically no longer~~where~~ hardly any surface area which faces towards the wind), the rotor blade 1 is parallel to the lower edge 16 that is towards the pod 18 and the spacing between the lower edge 16 and the external contour of the pod is at a minimum, preferably being less than 50 cm or even better less than 20 cm.

~~When now that~~the ~~rotor blade 1 is set into the wind, it involves a surface area of maximum size even in the very near region of the rotor blade (the slip hole is very small). The above-mentioned reference Erich Hau shows that the rotor blade in the state of the art decreases regularly in the region near the hub (the rotor blades are there less wide than at their widest location) and conversely in the case of the rotor blade 1 according to the invention the widest location is precisely in the region near the hub so that there, the wind potential can also be utilised~~utilized ~~to the best possible extent.~~

As is known, it is precisely when dealing with very large rotor blades 1 that a very great rotor blade width is involved in the region near the hub 17. ~~So that~~ In order for such rotor blades 1 ~~can still~~to be transported ~~(in the case of large rotor blades, that is to say rotor blades which are longer than 30 m, the width of the~~

~~rotor blade in the region near the hub can certainly be between 5 m and 8 m)~~, the rotor blade 1 can be of a two-part configuration, in which ~~case~~ the two parts are separated during transport and ~~can be fitted together~~re-assembled after transport. ~~For that purpose~~In such an embodiment, the two parts are connected together before being installed on the wind power installation, for example by way of screw connections and/or ~~non-releasable~~secure connections (e.g., adhesive). ~~That is no problem in particular when dealing with l~~Large rotor blades ~~as, by virtue of their size, the rotor blades are also~~may be accessible from the interior for being fitted together so that ~~this affords~~such a rotor blade can have of a unitary assembled appearance ~~to~~ on the exterior and the separation lines ~~at the parts when fitted together~~ are scarcely visible or not visible at all.

As initial measurements show, the rotor blade 1 ~~design~~ according to embodiments of the present ~~the~~ invention can markedly have an ~~increase the~~increased efficiency in comparison with previous rotor blades.

As can be seen from Figures ~~1 to 17~~4-8, ~~in the case of a wind power installation 1 according to the invention~~ the rotor blades 1 ~~are of such a configuration that they~~ have their greatest profile depth in the region near the hub 17 ~~and i~~In addition, the rotor ~~blades~~blade portions, along their ~~entire~~ respective edge profiles, are ~~moved~~ configured ~~in the region near the hub~~ to ~~be very close~~substantially conform to the contour of the hub cladding 17 and/or the pod cladding 21 ~~(spinner) of the machine housing of the wind power installation~~. Accordingly, at least for the position in which the rotor blade 1 assumes an angle ~~which is adopted~~that corresponds to ~~at~~ wind speeds up to the nominal wind range, ~~that means that~~ there ~~is~~ may be a very small spacing relative to the pod cladding 21. ~~While, in the view as shown, for example, in Figures 1, 2 and 3, the rotor blades 1 are also moved very close to the outer cladding of the pod with the rear part of their profile, .~~

Figure 16 illustrates a seamless transition between the feathering portion of the rotor blade 1 and the non-feathering portion 30 is indicated in by the lack of any demarcation line between the blade portions 1 and 30.

~~In an alternative embodiment as is shown for example in Figures 11 to 17, provides that the outer cladding of the pod 18 is provided with a~~ The rotor blade portion 30 ~~itself~~, which as previously stated, ~~however~~ is ~~itself~~ not an integral constituent part of the overall rotor blade 1 is affixed to the pod 18, or more specifically to the hub cladding 19 of the hub 17. ~~Thus, it can be clearly seen in particular from Figures 15 and 17 that the~~ The rotor blade ~~part~~ portion 30 ~~which is provided~~located on the outside of the pod is fixed ~~there~~ thereto and ~~is~~ arranged at an angle corresponding to the angular position of a rotor blade 1 up to the nominal wind speed~~, so that, at least~~. Thus, at wind speeds up to the nominal wind, there ~~is a~~are minimal gaps between the lower edge 16 of the rotor blade 1, the rotor blade portion 30, ~~even in the rear region of the profile depth,~~ and the pod 18, respectively. The rotor blade portion 30 can be screwed to the pod 18 or can also be glued or joined in one piece to the pod 18.

~~It can also be clearly seen from~~ Figure 19 illustrates that there is only a quite small 'slip hole' for the wind that cannot be seen from a distance by virtue of the configuration ~~according to the invention~~ of the rotor blades 1 in relation to the rotor blade portion 30~~at the centrecenter of the rotor~~.

Figure 18 shows a cross-section through a rotor blade according to the invention as taken along line A-A in Figure 17, that is to say the profile of the rotor blade in the region near the hub.

Figure 17 also includes an indication of what is to be understood by the diameter D of the spinner.

The rotor diameter is described by the diameter of the circular area which is covered by the rotor when it rotates.

As can be seen from Figure 15 and other Figures the ~~part~~ rotor blade portion 30 of the rotor blade 1 which is not an integral constituent part of the

rotatable rotor blade 1 is an integral constituent part of the outside cladding 19 of ~~the pod~~at least the hub 17. The respective ~~part~~ portion 30 can be screwed to the pod or can also be glued or joined in one piece to the pod.

Referring back to Figure 11, a wind and/or weather sensor 31 is attached to the pod 18 according to one illustrated embodiment. The sensor 31 can measure a variety of parameters such as wind velocity, direction, temperature, etc. This information may be recorded or transmitted.

TABLE 1

X-Y-COORDINATES

| x | y |
|---|---|
| 1.000000 | 0.013442 |
| 0.983794 | 0.020294 |
| 0.958357 | 0.030412 |
| 0.930883 | 0.040357 |
| 0.899462 | 0.050865 |
| 0.863452 | 0.062358 |
| 0.823890 | 0.074531 |
| 0.781816 | 0.086987 |
| 0.737837 | 0.099513 |
| 0.692331 | 0.111993 |
| 0.645363 | 0.124434 |
| 0.597614 | 0.136709 |
| 0.549483 | 0.148731 |
| 0.503007 | 0.160228 |
| 0.481036 | 0.170758 |
| 0.425769 | 0.179639 |
| 0.397598 | 0.186588 |
| 0.374996 | 0.191889 |
| 0.356186 | 0.195840 |
| 0.339750 | 0.198668 |
| 0.324740 | 0.200524 |
| 0.310542 | 0.201512 |
| 0.296731 | 0.201704 |
| 0.232999 | 0.201174 |
| 0.269154 | 0.200007 |
| 0.255115 | 0.198267 |
| 0.240876 | 0.195985 |
| 0.226479 | 0.193185 |
| 0.212006 | 0.189892 |
| 0.197571 | 0.186146 |
| 0.183315 | 0.181995 |
| 0.169384 | 0.177505 |
| 0.155924 | 0.172745 |
| 0.143051 | 0.167780 |

| x | y |
|---|---|
| 0.130850 | 0.162675 |
| 0.119369 | 0.157478 |
| 0.108625 | 0.152229 |
| 0.098610 | 0.146953 |
| 0.089297 | 0.141664 |
| 0.080653 | 0.136362 |
| 0.072636 | 0.131036 |
| 0.065201 | 0.125679 |
| 0.058312 | 0.120269 |
| 0.051931 | 0.114786 |
| 0.046015 | 0.109229 |
| 0.040531 | 0.103598 |
| 0.035457 | 0.097893 |
| 0.030772 | 0.092113 |
| 0.026461 | 0.086252 |
| 0.022520 | 0.080332 |
| 0.018937 | 0.074321 |
| 0.015688 | 0.068240 |
| 0.012771 | 0.062095 |
| 0.010196 | 0.055378 |
| 0.007926 | 0.049601 |
| 0.005911 | 0.043298 |
| 0.004164 | 0.036989 |
| 0.002755 | 0.030661 |
| 0.001709 | 0.024300 |
| 0.000953 | 0.017915 |
| 0.000415 | 0.011534 |
| 0.000088 | 0.005186 |

| x | y |
|---|---|
| 0.000000 | 0.000000 |
| 0.000197 | -0.007376 |
| 0.000703 | -0.013612 |
| 0.001550 | -0.019816 |
| 0.002704 | -0.025999 |
| 0.004080 | -0.032162 |
| 0.005649 | -0.038281 |
| 0.007477 | -0.044316 |
| 0.009639 | -0.050245 |
| 0.012124 | -0.056078 |
| 0.014883 | -0.061829 |
| 0.017905 | -0.067491 |
| 0.021204 | -0.073045 |
| 0.024779 | -0.078485 |
| 0.028618 | -0.083809 |
| 0.032721 | -0.089004 |
| 0.037087 | -0.094062 |
| 0.041711 | -0.098973 |
| 0.046594 | -0.103723 |
| 0.051740 | -0.108301 |
| 0.057150 | -0.112695 |
| 0.062824 | -0.116897 |
| 0.068769 | -0.120893 |
| 0.074991 | -0.124669 |
| 0.081500 | -0.128219 |
| 0.088310 | -0.131521 |
| 0.095450 | -0.134551 |
| 0.102955 | -0.137294 |

| x | y |
|---|---|
| 0.110872 | -0.139735 |
| 0.119262 | -0.141872 |
| 0.128192 | -0.143724 |
| 0.137734 | -0.145316 |
| 0.147962 | -0.146667 |
| 0.158934 | -0.147800 |
| 0.170663 | -0.148727 |
| 0.183106 | -0.149431 |
| 0.196155 | -0.149877 |
| 0.209657 | -0.150001 |
| 0.223475 | -0.149715 |
| 0.237539 | -0.148932 |
| 0.251855 | -0.147579 |
| 0.266497 | -0.145597 |
| 0.281578 | -0.142949 |
| 0.297206 | -0.139628 |
| 0.313400 | -0.135651 |
| 0.330088 | -0.131016 |
| 0.347173 | -0.125692 |
| 0.364627 | -0.119588 |
| 0.382602 | -0.112537 |
| 0.401480 | -0.104293 |
| 0.421912 | -0.094548 |
| 0.444568 | -0.083182 |
| 0.468376 | -0.071217 |
| 0 491608 | -0.060017 |
| 0 514034 | -0.049898 |
| 0.535806 | -0.040854 |

| x | y |
|---|---|
| 0.557225 | -0.032760 |
| 0.578580 | -0.025495 |
| 0.600131 | -0.018956 |
| 0 622095 | -0.013059 |
| 0.644620 | -0.007755 |
| 0.667811 | -0.003015 |
| 0.691690 | 0.001179 |
| 0.716104 | 0.004827 |
| 0.740707 | 0.007908 |
| 0.364985 | 0.010392 |
| 0.788448 | 0.012236 |
| 0.810817 | 0.013425 |
| 0.832004 | 0.013957 |
| 0.852100 | 0.013834 |
| 0.871284 | 0.013058 |
| 0.889797 | 0.011606 |
| 0.907926 | 0.009441 |
| 0 925997 | 0.006502 |
| 0.944381 | 0.002701 |
| 0.963552 | -0.002134 |
| 0.984409 | -0.008335 |
| 1.000000 | -0.013442 |
| 0.000197 | -0.007376 |
| 0.000703 | -0.013612 |
| 0.001550 | -0.019816 |
| 0.002704 | -0.025999 |
| 0.004080 | -0.032162 |
| 0.005649 | -0.038281 |

| x | y |
|---|---|
| 0.007477 | -0.044316 |
| 0.009639 | -0.050245 |
| 0.012124 | -0.056078 |
| 0.014883 | -0.061829 |
| 0.017905 | -0.067491 |

| x | y |
|---|---|
| 0.021204 | -0.073045 |
| 0.024779 | -0.078485 |
| 0.028618 | -0.083809 |
| 0.032721 | -0.089004 |
| 0.037087 | -0.094062 |

All of the above U.S. patents, U.S. patent application publications, U.S. patent applications, foreign patents, foreign patent applications and non-patent publications referred to in this specification and/or listed in the Application Data Sheet, are incorporated herein by reference, in their entirety.

From the foregoing it will be appreciated that, although specific embodiments of the invention have been described herein for purposes of illustration, various modifications may be made without deviating from the spirit and scope of the invention. Accordingly, the invention is not limited except as by the appended claims.